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SUBSTITUTE SPECIFICATION

COMPONENT OF A FLOW MACHINE, WITH INSPECTION APERTURE

Field of the Invention

[0001] The present invention relates to a component of a flow machine, particularly of a gas turbine, which has cooling channels for a cooling medium and also at least one inspection aperture through which an inspection of the interior of the component is made possible, and also a process for the inspection and/or cleaning of the interior of such a component.

Background of the Invention

[0002] For the attainment of a high efficiency factor, modern high temperature gas turbines require a carefully devised cooling system, particularly for the cooling of the highly loaded turbine blades. The turbine blades have for this purpose one or more chambers and/or channels constructed as cavities, via which a cooling medium can be supplied to the blades from the rotor side. As a rule, numerous cooling air bores are provided at the leading region of the turbine blades at their forward edge, and the cooling medium can emerge through them from the interior of the blade. A cooling air film forms on the surface in this region and protects the turbine blade from excessive heating. In the same way, corresponding cooling air bores are also present at the rear edge of the turbine blade.

[0003] A problem with such hollow components, such as turbine blades or combustion chamber elements, which are frequently cast in one piece, is represented by the poor accessibility of the interior of these components. Their inspection, for example for internal damage such as cracks, or for dirt deposits, is therefore as a rule difficult.

[0004] To avoid this problem, it is known, for example from DE 198 01 804 A1, to install, in addition to the cooling air bores which are necessary in each case, one or more inspection access apertures in the outer wall of the turbine blade, through which bores the blade interior can be investigated with a corresponding inspection tool. Such an inspection aperture or inspection access aperture also makes possible the inspection of an already

built-in turbine blade, and also the cleaning from the interior of the turbine blade of dirt deposits which could lead to blockage of the very narrow cooling air bores. The document provides for the introduction of a special cleaning tool through the inspection access aperture for this purpose.

Summary of the Invention

[0005] The present invention provides a hollow component of a flow machine, such as a turbine engine, in such a manner that both the inspection and also a reduction of the danger of a blockage of the cooling air bores can be implemented in a simple manner.

[0006] The component with cooling channels for a cooling medium and also at least one inspection aperture through which inspection of the interior of the component is made possible is characterized in that the inspection aperture is arranged on the component, and is dimensioned, in such a manner that it simultaneously forms a dust discharge aperture for dust or dirt particles contained in the cooling medium.

[0007] A "dust discharge aperture" refers to an aperture in the wall of the component by means of which particles entrained in the cooling medium emerge from the interior of the component due to their inertia. A dust discharge aperture should therefore be arranged at a deflection of the channel conducting the cooling medium or at the end of a dust channel branching from this channel at a corresponding deflection. Such dust discharge apertures are already used in components of flow machines in order to prevent a blockage of the cooling channel bores. An example of an embodiment of a turbine blade with such a dust discharge aperture can be gathered from U.S. Patent 4,820,122, for example. The interior of the turbine blade here has cooling air channels which run in a serpentine manner. The branching into the individual serpentine channels takes place in the region of the entry of the cooling air into the turbine blade at the rotor. A straight channel extends radially as a direct extension of the inlet channel and leads directly to a dust discharge aperture at the blade tip. Particles entering with the cooling air are conveyed, due to the force of the cooling air, directly in a straight line radially to this dust discharge aperture, while nearly dirt-free air can enter the other serpentine channels without problems. The dust particles are thus conducted out of the cooling channels

into the open air through this dust discharge aperture or this dust hole, so that the cooling air bores are not blocked by the dust particles.

[0008] The inventor of the present invention has now discovered that inspection access apertures, by skillful arrangement, can fulfill the function of dust discharge apertures, or that dust discharge apertures, by suitable dimensioning, particularly enlargement, can serve as inspection access apertures. The dust discharge apertures according to the invention are designed in size and position both so that dust is favorably discharged and also an aperture with sufficient diameter is formed in order to be able to introduce a borescope through this aperture.

[0009] The inspection aperture or inspection bore, which at the same time represents a dust discharge aperture, is preferably already considered when the component is cast and not, as is the case with the cooling air apertures, introduced by subsequent drilling. In rotating blades, this inspection and dust discharge aperture is preferably located in the neighborhood of the blade tip. In order to be able to inspect these blades even in the built-in state of the machine, these inspection and dust discharge apertures are to be arranged approximately parallel to the machine axis, if the inspection tool is to be introduced in the hot gas path of the gas turbine. If the inspection tool is to be introduced radially into the machine, a position at the blade tip is more favorable in which the inspection and dust discharge aperture runs radially of the machine axis. By the combination according to the invention of the dust discharge and the inspection function in one and the same aperture, unnecessary apertures are avoided which can lead to an undesired loss of cooling medium and thus bring about a loss of efficiency.

Brief Description of the Drawings

[0010] The invention is described below with reference to the embodiments shown in the accompanying drawing, without limitation of the general concept of the invention in any way.

[0011] Fig.1 is a diagram schematically showing a section through a turbine blade in accordance with an embodiment of the invention.

[0012] Fig. 2 is a further example, in cross section, of a turbine blade according to another embodiment of the present invention.

Detailed Description of the Preferred Embodiments

[0013] Fig. 1 schematically shows in cross section a turbine blade with a blade foot 1, platform 2, and blade 3. Cooling air is supplied to the turbine blade from the blade foot 1 by means of the cavity 4 visible in the cross section. A dust discharge aperture 5 is shown at the blade tip in the forward region, i.e., in the leading region of the turbine blade, and dirt particles entrained with the cooling medium are discharged, due to their inertia, from the hollow channel 4 through the said dust discharge aperture 5. Due to the high flow speed of the cooling medium at the deflection of the cooling channel 4 present at the dust discharge aperture 5, the particles, due to their large mass, take the path through the dust discharge aperture 5 and do not pass via the deflection into the further course of the cooling channel, in which relatively dust-free air thus flows. The cooling air flows past the pins 6 and leaves the blade by means of apertures at the rear edge, for example, by means of a slit.

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~~[0014] The dust discharge aperture 5 is, according to the invention, constituted with a large enough diameter for the introduction of a borescope to be possible through this aperture 5 into the interior of the turbine blade. In this manner, the interior of this component can be inspected at any time, even in the built-in state.~~

~~[0015] Finally, Fig. 2 shows a further example, in which the dust discharge aperture 5 however runs, not radially, but in the axial direction. In this example also, the blade foot 1, platform 2, and turbine blade 3 can again be seen in cross section. The cooling channel 4 runs in the same way as in Fig. 1. The dust hole 5, which in this example runs parallel to the machine axis, makes inspection possible with an inspection tool introduced in the hot gas path. The mechanism of dust extraction is the same as that in Fig. 1. In this example, the dirt particles, due to their inertia and the high flow speed of the deflected cooling medium, take the path via the channel 7 leading to the dust hole 5, while the cooling medium is deflected at the branch without problems in the direction toward the machine axis and is therefore conducted, relatively dust-free, past the pins 6 to the cooling air apertures at the rear edge of~~

the blade. The dust hole 5 or the channel 7 leading to this are hence again constituted with a large enough diameter for the introduction of an inspection tool, particularly a borescope, to be possible into the interior of the turbine blade.